299-E33-339 (C3392)

Log Data Report

Borehole Information:

Borehole: 299-E33-337 (C3392)		Site: BX Farm Perimeter			
Coordinates		GWL (ft)[1]: ~260		GWL Date: 7/26/01	
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A[3]	N/A	7/19/01	Not available	280.69	

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Steel-threaded drill pipe	~ 1 in		9 1/4	3/4	0	~281

Borehole Notes:

This is a RCRA groundwater well that was logged through the drill pipe.

Logging Equipment Information:

Logging System: Gamma 2B		Type: SGLS (35%)
Calibration Date:	Calibration Reference:	
	Logging Procedure: MAC-HGLP 1.6.5	

Logging System: RLS 1		Type: Moisture
Calibration Date: 7/11/01	Calibration Reference: RLSM00.0	
	Logging Procedure:	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4/Repeat	
Date	7/27/01	7/30/01	7/31/01	8/01/01	
Logging Engineer	Musial	Musial	Musial	Musial	
Start Depth (ft)	0	54	163	285	
Finish Depth (ft)	55	164	262	233	
Count Time (sec)	200	200	200	200	
Live/Real	L	L	L	L	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
ft/min	n/a	n/a	n/a	n/a	
Pre-Verification	B00025CAB	B00026CAB	B00027CAB	B00028CAB	
Start File	B0025000	B0026000	B0027000	B0028000	
Finish File	B0025055	B0026110	B0027099	B0028052	
Post Verification	B00025CAA	B00026CAA	B00027CAA	B00028CAA	

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2	3		
Date	7/26/01	7/26/01	7/26/01		
Logging Engineer	Musial/Kos	Musial	Musial		
Start Depth (ft)	0	120	240		
Finish Depth (ft)	120	240	263.25		
Count Time (sec)	n/a	n/a	n/a		
Live/Real	n/a	n/a	n/a		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	0.25	0.25	0.25		
ft/min	1.0	1.0	1.0		
Pre-Verification	C0092CAB	C0092CAB	C0092CAB		
Start File	C009000	C009481	C0010000		
Finish File	C009480	C009961	C0010096		
Post Verification	C0102CAA	C0102CAA	C0102CAA		

Logging Operation Notes:

A longer count time (200 sec) was required with the SGLS because of the relatively thick casing. The borehole was logged in the drill pipe before completion as a groundwater monitoring well. In order to obtain reliable spectra while minimizing overall logging time, the depth interval was increased from 0.5 ft to 1.0 ft.

SGLS log depths are relative to ground level. During logging run 2, a fine gain adjustment occurred at file B0026089 (143 ft) from 2123 to 2126 channels. The hole is open at the end of the drill pipe at 281 ft.

Neutron moisture logs were run on 7/26/01 using the RLS 1, and log depths are relative to ground level. The neutron moisture tool was run centralized. The end of the sonde had about 6 in. of muck on it when brought to surface.

Analysis Notes:

Analyst:	Sobczyk	Date:	08/07/01	Reference:	

Pre-run and post run verification spectra for the SGLS were evaluated. All of the pre-survey verification spectra were within the control limits. The post-survey verification spectrum for logging run 1 (file B00025CAA) was the only post-survey verification spectrum that was outside of the control limits. The peak cps for the 609-keV peak was below the lower control limits for this post run verification spectra. Examinations of spectra indicate that the detector appears to have functioned normally during the log run. Individual spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL. Corrections were applied for a casing thickness of 3/4 in. from the ground surface to 281 ft. No casing correction was applied at 282 to 285 ft. A correction for water in the borehole was applied at and below 262 ft. Dead time corrections were not necessary.

Moisture calibration models at Hanford for 10-in. boreholes with ¾-in. casing have not been established. Thus, the neutron log was not processed to estimate volumetric moisture content because the relatively large borehole diameter and casing thickness are beyond the range of conditions for which the tool was calibrated. Neutron data are presented as gross counts. In general, an increase in neutron count is indicative of an increase in moisture content, but a quantitative calculation of volumetric moisture cannot be made at this time.

There is an apparent cyclic nature to this neutron log, which may be due to the manner in which the borehole was drilled. The period of the cycle appears to be about 12 ft. Water added to the hole during drilling and the use of joint compound at casing connections are potential causes.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (^{40}K, ^{232}Th, ^{238}U, and associated decay progeny), and man-made radionuclides. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable activity (MDA) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and does not include errors associated with the inverse efficiency function, dead time correction, or casing and water corrections. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. A neutron moisture log of neutron counts is also shown on the combination plot.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide that was detected. ^{137}Cs activity was observed at only one measurement, which was at the ground surface. The measured ^{137}Cs activity is about 0.7 pCi/g.

The changes in gross gamma counts depend primarily upon changes in ^{40}K activities. The increase in gross gamma counts from about 85 cps to about 117 cps at a log depth of 54 ft corresponds with an increase in apparent ^{40}K activity from about 14 pCi/g to 22 pCi/g. Similarly, the increase in gross gamma counts from 106 cps to 130 cps at a log depth of 170 ft corresponds to an increase in ^{40}K activity from about 22 pCi/g to 24 pCi/g as well as an increase in ^{232}Th activity from about 0.8 to 1.4 pCi/g. The increase in gross gamma counts from 90 cps to 150 cps at 244 ft corresponds to an increase in ^{40}K activity from about 16 pCi/g to 22 pCi/g, in ^{232}Th activity from about 0.8 to 1.4 pCi/g, and in ^{238}U activity from about 0.9 to 1.5 pCi/g. These apparent increases in total activity are due to relative decreases in sediment grain size. The apparent decreases in sediment grain size at about 170 ft and at 244 ft correspond with expected increases in neutron cps while the change at 54 ft does not have a corresponding increase in neutron cps. Generally, an increase in neutron counts is expected to occur where an increase gamma ray counts occurs. At a log depth of 54 ft, the increase in total gamma occurs without an increase in neutron counts probably because the spectral gamma ray tool has a deeper radius of investigation than the neutron moisture tool.

The neutron moisture tool's depressed response in this hole is due to the low-activity source, short source-to-detector spacing, and large borehole diameter. The elevated neutron cps that occur at about 170 ft and 244 ft correspond with intervals of relatively high total gamma. These zones are interpreted as layers of finer grained sediments surrounded by coarser sediments. The highest neutron counts occurred in the groundwater as expected. This interval corresponds with a slight drop in total gamma and ^{40}K activity.

The apparent increase in ^{238}U concentration below the groundwater level is interpreted as an indication of dissolved radon (^{222}Rn) in the water. Total gamma counts and count rates for the 1461 keV (^{40}K) and 2615 keV (^{208}Tl / ^{232}Th) gamma lines are observed to decrease below the water level because of increased attenuation as gamma rays pass through the water. Application of the water correction factor compensates for this attenuation. However, count rates for several gamma lines associated with ^{238}U were observed to increase at the groundwater level. These included the 351 keV (^{214}Pb), 609 keV (^{214}Bi), and 1764 keV (^{214}Bi) lines. ^{214}Pb and ^{214}Bi are the eighth and ninth members of a complex decay chain, which begins with ^{238}U and ends with ^{206}Pb. Under normal conditions, members of the decay chain are assumed to be in secular equilibrium, meaning that activities of each member of the chain in proportion to one another. Of the gamma lines emitted by the various ^{238}U decay progeny, those associated with ^{214}Bi and ^{214}Pb are the most prominent, and are commonly used to calculate ^{238}U concentration. In water, the radioactive equilibrium is less likely to be maintained, because Bi and U have differing chemical properties. Therefore, the presence of ^{214}Bi in water is not necessarily an indication of dissolved uranium. However, ^{214}Bi and ^{214}Pb are also decay products of ^{222}Rn, the gaseous member of the decay chain. As a gas, radon is relatively mobile and soluble in water. Establishment of secular equilibrium between ^{214}P, ^{214}Bi, and ^{222}Rn

requires only a few hours, and any radon dissolved in the groundwater would also result in increased ^{214}Pb and ^{214}Bi activity.

Note that the elevated ^{214}Bi levels observed in the groundwater do not suggest the presence of uranium contamination from a man-made source. Establishment of secular equilibrium between ^{214}Bi and ^{238}U requires a time period on the order of a million years, so the presence of ^{214}Bi is commonly taken as an indication of naturally occurring ^{238}U that has not be subjected to chemical separation. Man-made ^{238}U would be indicated by the presence of the 1001-keV gamma line associated with ^{234m}Pa, with little evidence of the 609- and 1764-keV lines associated with ^{214}Bi. The apparent increase in gross gamma counts at the bottom of the hole (282 ft through 285 ft) occurs because the detector is not being shielded by the drill pipe.

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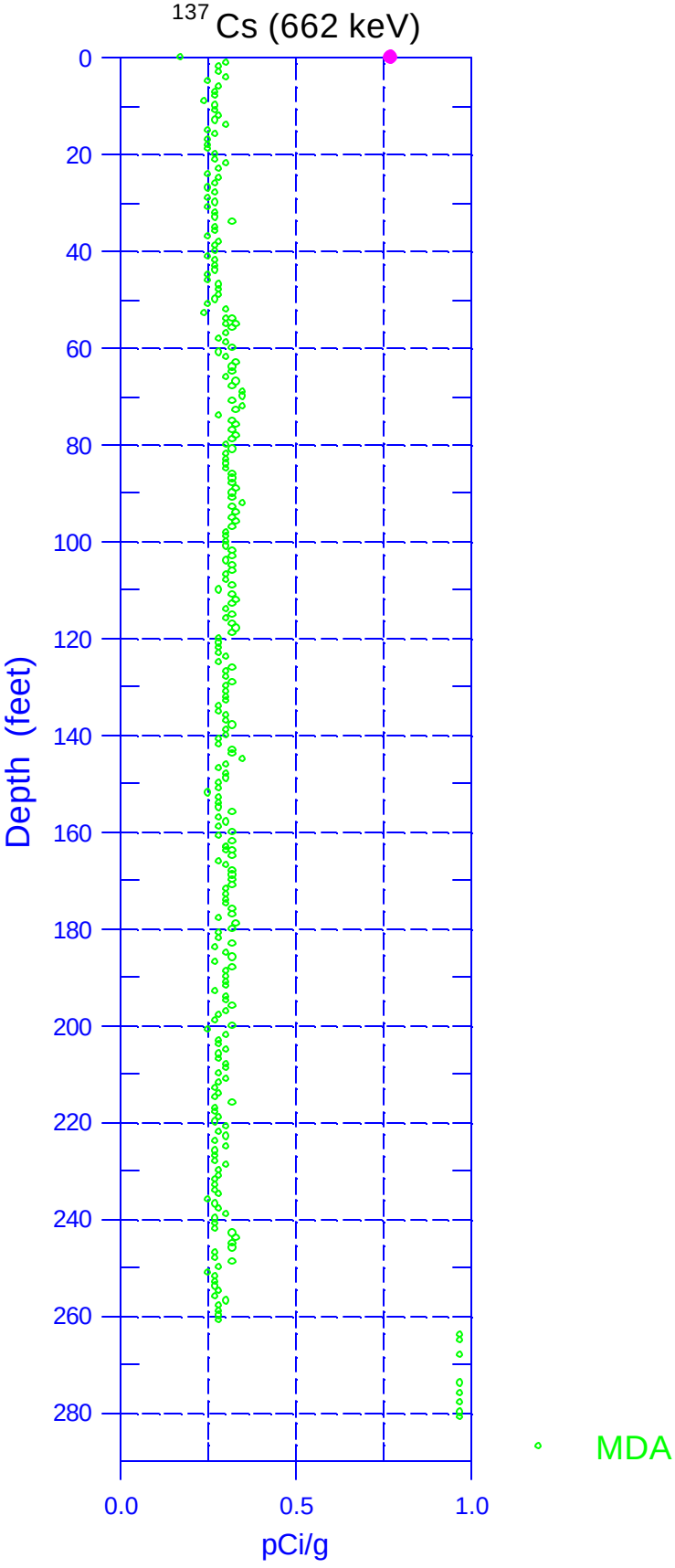
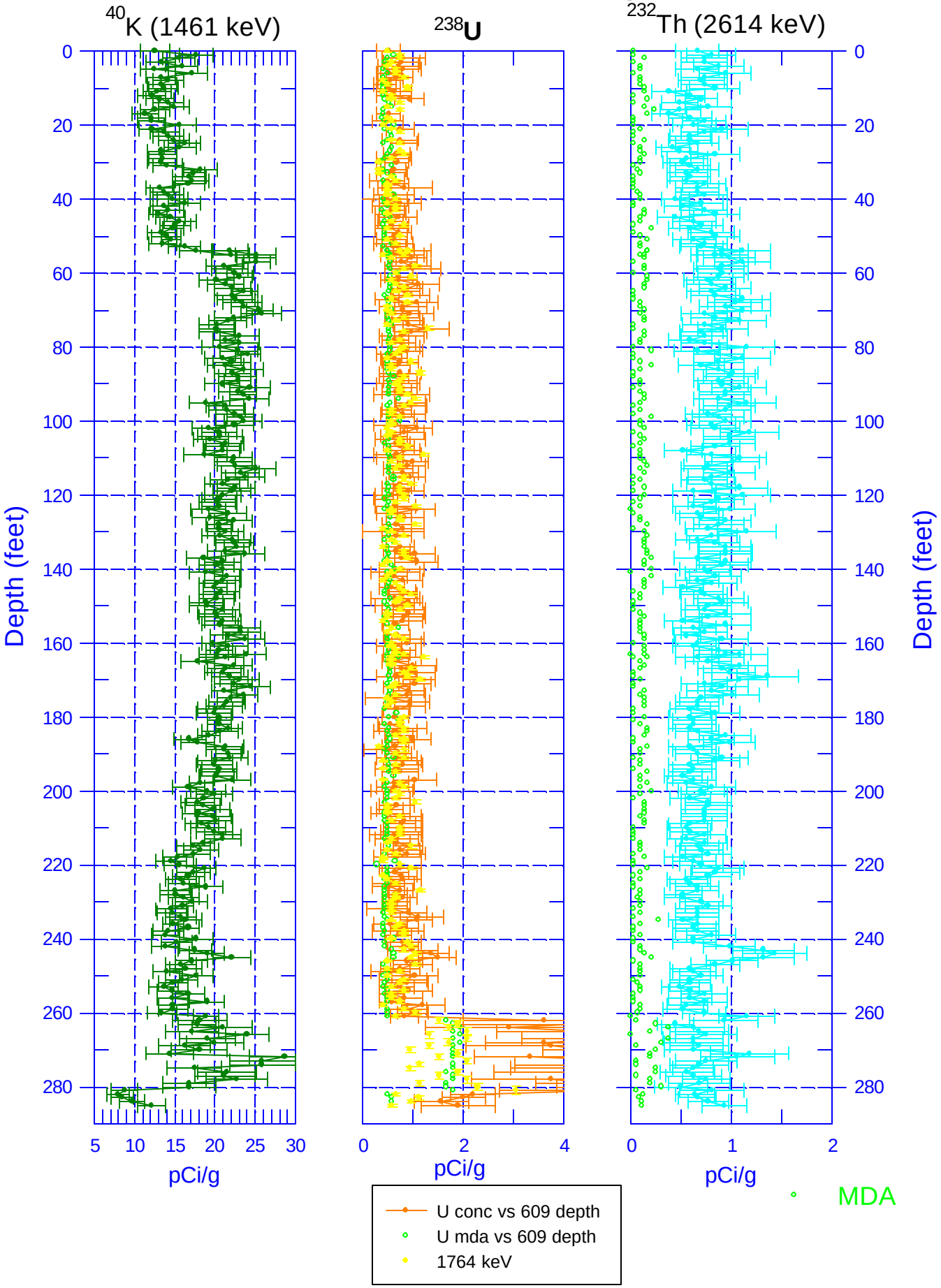
[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not applicable

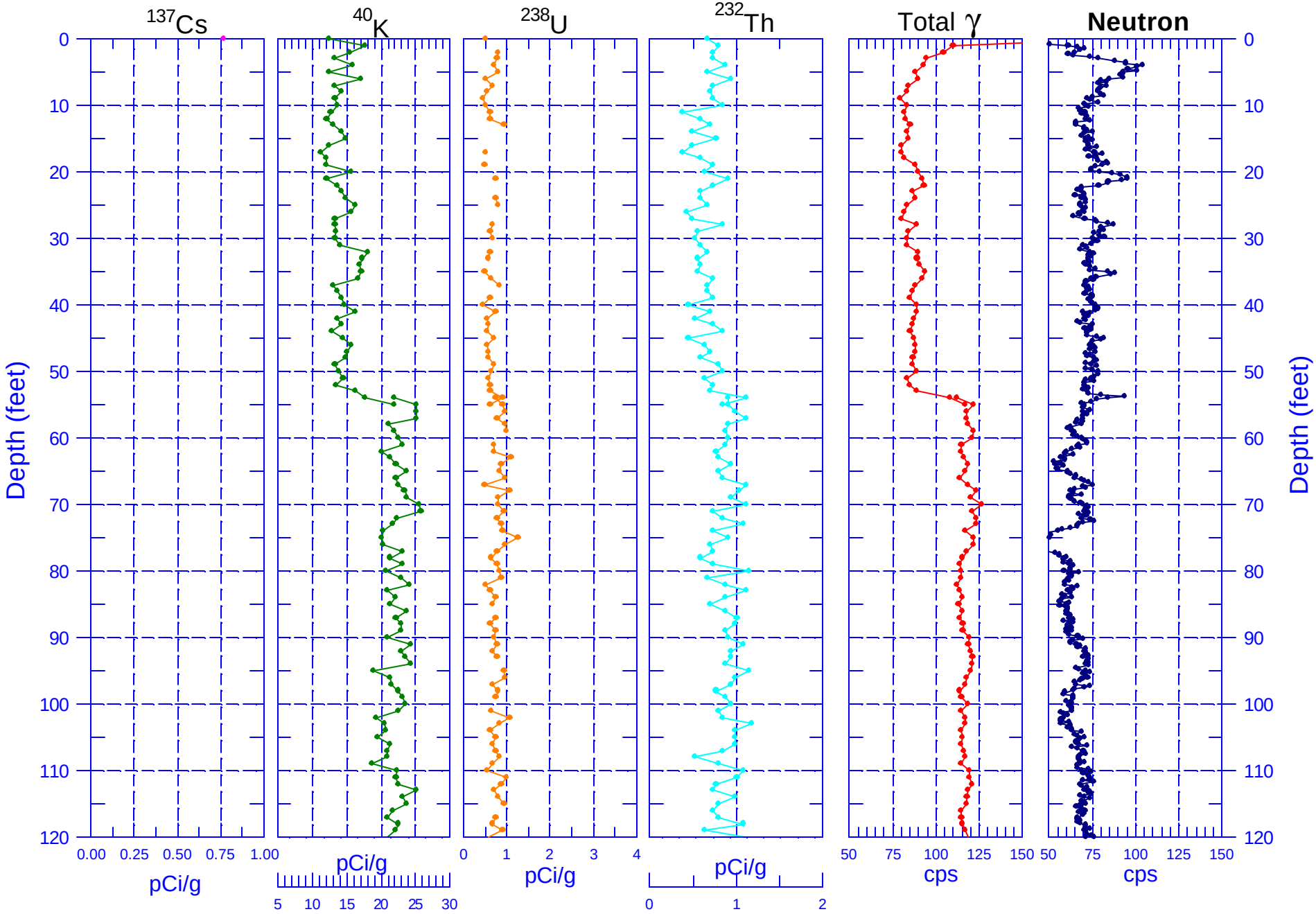
299-E33-339 (C3392)
Man-Made Radionuclide Concentrations

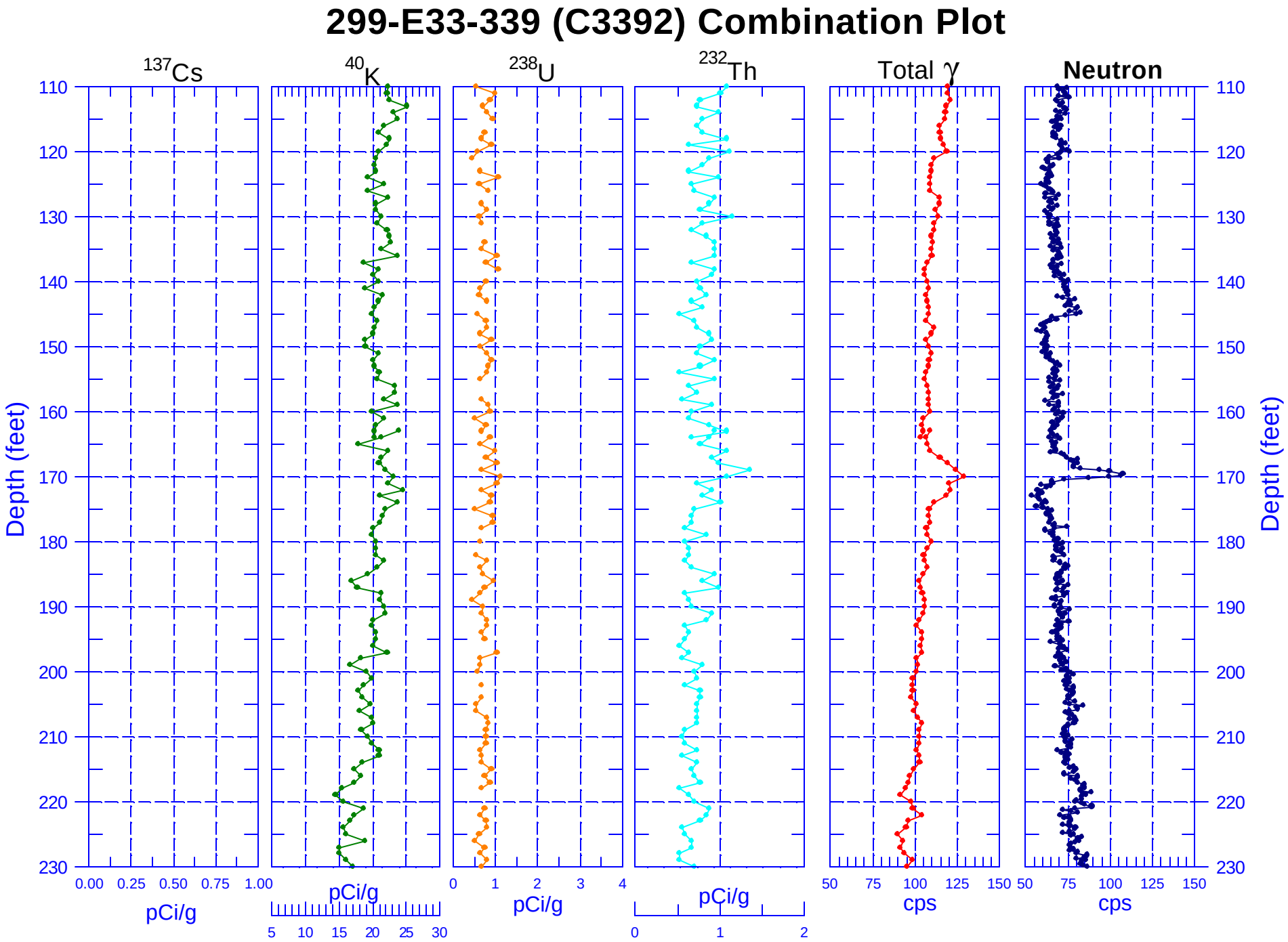


299-E33-339 (C3392)
Natural Gamma Logs

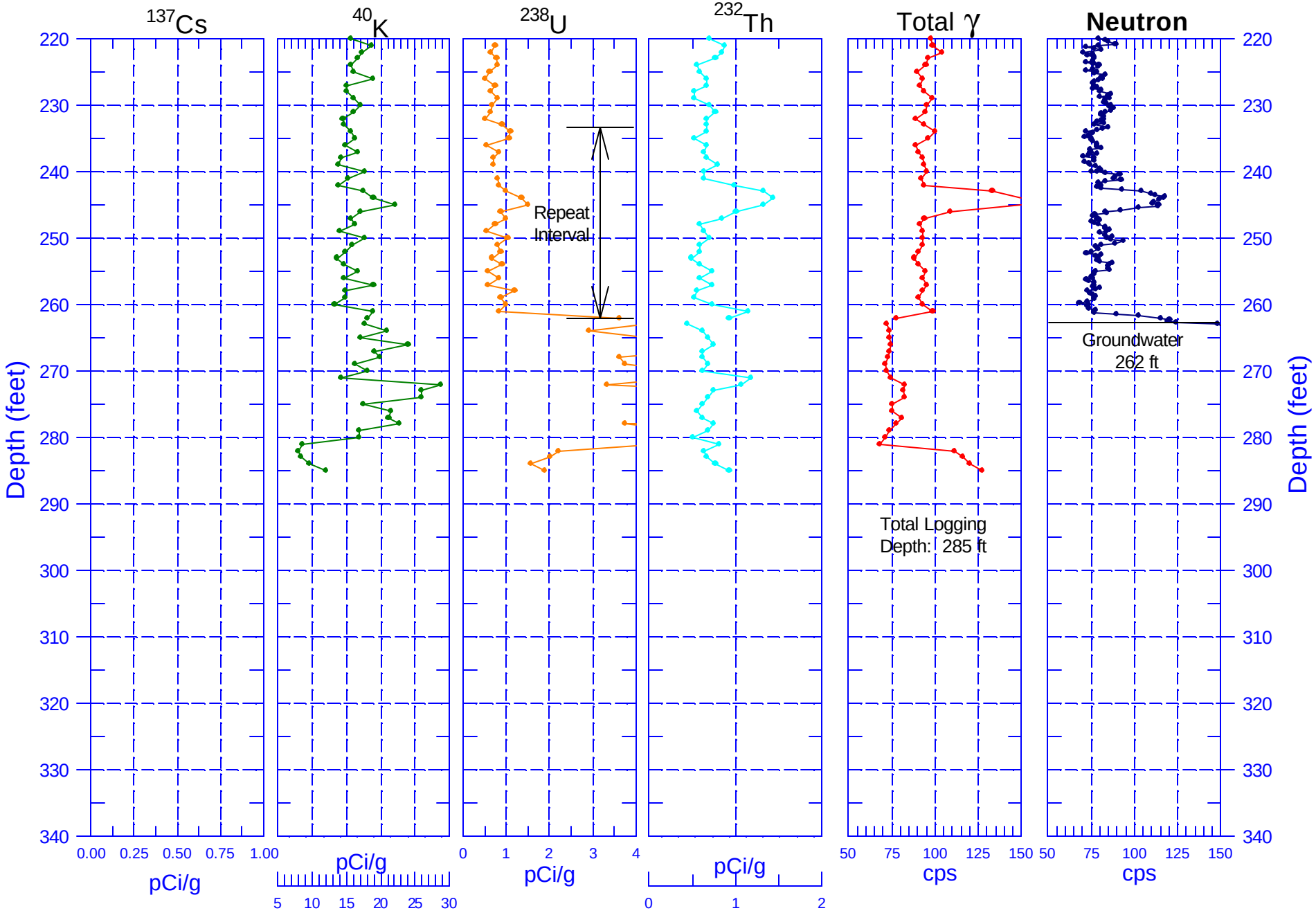


299-E33-339 (C3392) Combination Plot



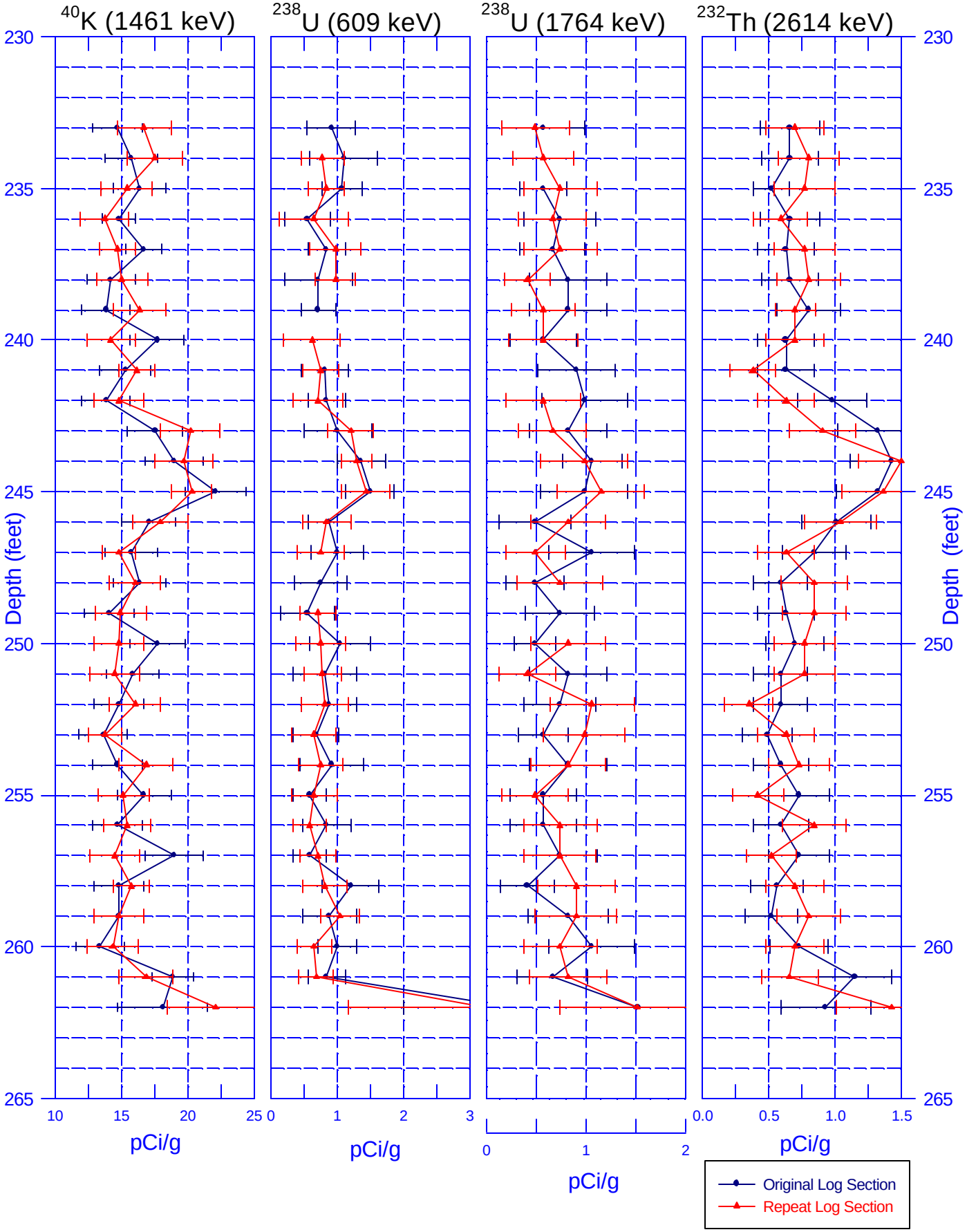

299-E33-339 (C3392) Combination Plot
137Cs
40K
238U
232Th
Total γ
Neutron
Depth (feet)
110
120
130
140
150
160
170
180
190
200
210
220
230
0.00 0.25 0.50 0.75 1.00
pCi/g
5 10 15 20 25 30
pCi/g
0 1 2 3 4
pCi/g
0 1 2
pCi/g
50 75 100 125 150
cps
50 75 100 125 150
cps

299-E33-339 (C3392) Combination Plot



299-E33-339 (C3392)

Rerun Section of Natural Gamma Logs



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